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## NOTES FROM PACIFIC COAST OBSERVATORIES.

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### THE PRODUCTION OF CERTAIN BANDED SPECTRA IN THE ELECTRIC FURNACE.

Experiments have recently been made with the electric furnace to obtain evidence on the origin and observe the behavior at various temperatures of the banded spectra which have been ascribed by Fowler and others to titanium oxide, magnesium hydride and calcium hydride, respectively. All of these bands occur in sun-spot spectra, and the probability that the first named, the "Antarian bands," are due to titanium oxide has been taken as indicating the presence of oxygen in the Antarian stars as well as in the Sun.

It was noted in a previous investigation that these Antarian bands do not appear when titanium is vaporized in the furnace in vacuum. The present work was undertaken to see if the presence of oxygen would bring out the bands in the furnace as it does in the arc. Tests with air in the furnace chamber at one-half atmosphere and at atmospheric pressure did not give the bands. It seemed, however, that this might indicate simply a lack of oxygen in the furnace tube due to its carbon immediately using up the oxygen of the contained air, there being little circulation thru the horizontal tube. The windows of the furnace chamber were therefore removed, and a plentiful supply of air was introduced directly into the tube by means of a silica tube attached to a bellows. The band spectrum then appeared with great intensity. Altho pure oxygen has not yet been tried in the furnace, it is fairly certain that the banded spectrum is brought out by the oxygen of the air, since it has been found with the arc that an atmosphere of nitrogen suppressed the bands.

When the bands were made strong in the furnace, the line spectrum, at least in the yellow and red region under examination,

was rendered very faint, as if all the titanium vapor were turned into the oxide, and this gave the band spectrum alone. No decided change in temperature was evident when air was used in the tube.

It may be noted that this use of the furnace produces what may be regarded as a very hot flame spectrum, since the metallic vapor in the tube is raised to a high temperature and the oxygen is then supplied for the flame effects.

Experiments with the furnace in vaporizing magnesium and calcium in an atmosphere of hydrogen confirms the arc results as to the effect of hydrogen in bringing out the bands ascribed to the hydrides of these elements. Both sets of bands can be produced faintly with the furnace pumped out, but the spectrum of the "tube-arc" has shown that considerable hydrogen is present under such conditions, probably occluded by the graphite tube. The use of hydrogen in the furnace chamber at different pressures and temperatures gave rather variable results until the method was adopted of passing a stream of hydrogen thru the furnace tube during the exposure, the pressure in the chamber being maintained at from 10 to 20 cm. of mercury. The bands were then obtained moderately strong without, however, any perceptible weakening of the line spectrum. The best defined bands in these bands are at  $\lambda\lambda$  4845, 5211, 5261 for magnesium and  $\lambda\lambda$  6382, 6389 for calcium. A temperature not higher than  $2200^{\circ}$  C. seemed to be most favorable for them. At  $2500^{\circ}$  the bands were weaker and were liable to appear in absorption, as if they were given by the cooler vapor near the end of the tube.

These results indicate that the strengthening of the titanium, magnesium, and calcium bands by the presence of oxygen or hydrogen, observed in the arc experiments, does not depend on an alteration of the arc discharge by the surrounding gas, and point to the formation of a compound at moderate temperature in each case.

ARTHUR S. KING.

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#### THE MAGNESIUM LINE $\lambda$ 4571 IN THE ELECTRIC FURNACE.

In some experiments made in 1904 with a furnace consisting of a carbon tube tested by an arc playing on the outside, I observed a